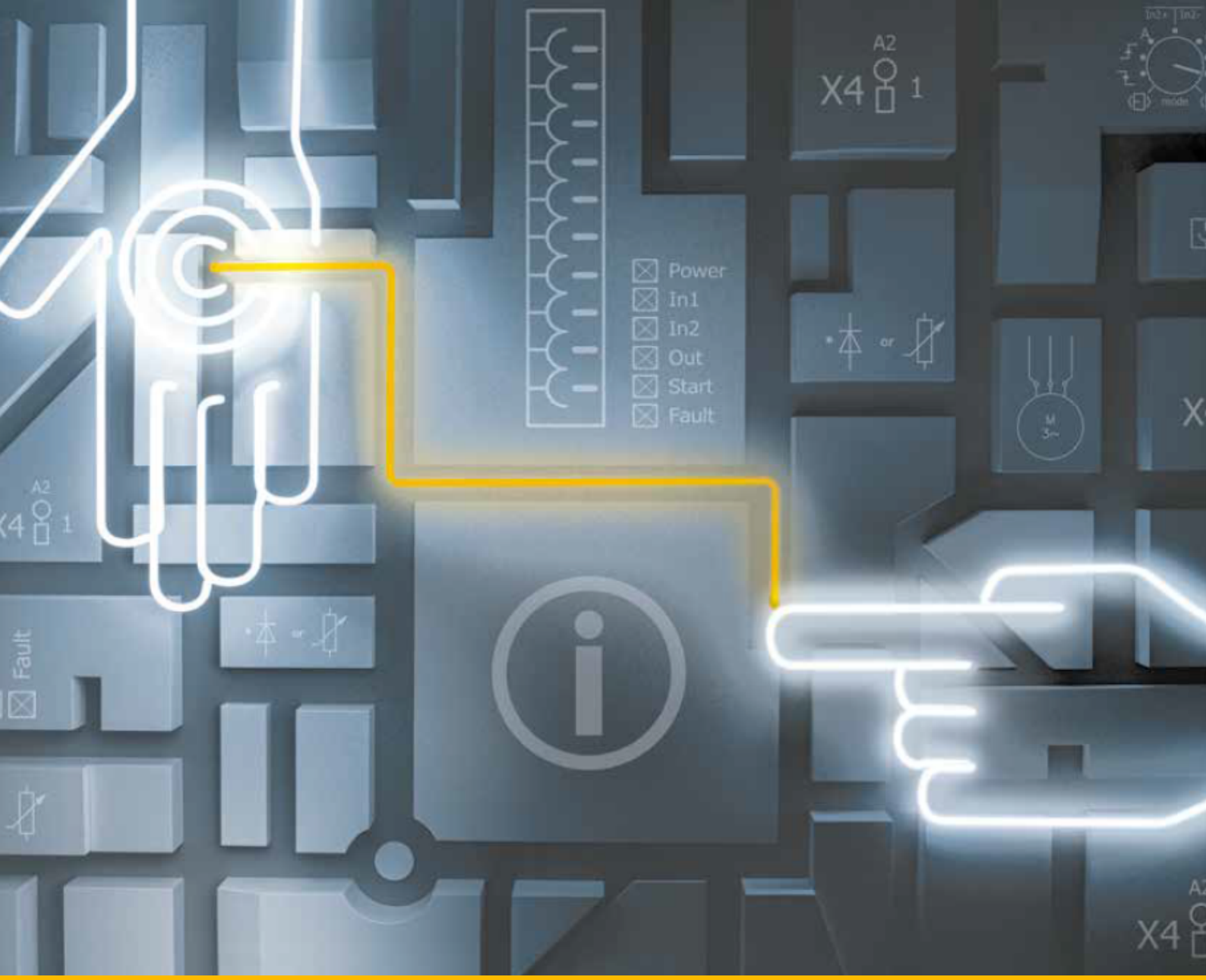


PSS u2 EF 2AI I (-R)

PILZ
THE SPIRIT OF SAFETY

Operating Manual-1005180-EN-03

- PSS u2 in the automation system PSS 4000
- Remote I/O system PSS u2

This document is a translation of the original document.

Where unavoidable, for reasons of readability, the masculine form has been selected when formulating this document. We do assure you that all persons are regarded without discrimination and on an equal basis.

1 Introduction

1.1 Validity of documentation

This operating manual explains the function and operation, describes the installation and provides guidelines on how to connect the product.

This documentation is valid for the product PSS u2 EF 2AI I from Version HW 2.0, FW 1.1. It is valid until new documentation is published.

This documentation is valid for the product PSS u2 EF 2AI I -R from Version HW 1.0, FW 1.1. It is valid until new documentation is published.

1.2 Using the documentation

This document is intended for instruction. Only install and commission the product if you have read and understood this document. The document should be retained for future reference.

Please refer to the PSS u2 Installation Manual.

1.3 Terminology

PSS u2 system

A PSS u2 system consists of a PSS u2 head module, main voltage supply module and optional PSS u2 electronic modules with backplanes.

Remote I/O system PSS u2

PSS u2 system without control functionality that provides I/Os. The I/Os can be controlled via a fieldbus.

The configuration is performed in the tool PASconfig.

PSS u2 in the automation system PSS 4000

A PSS u2 system can be used in the automation system PSS 4000. A PSS u2 system is a 2nd generation device in the automation system PSS 4000.

The configuration is performed in the tool PAS4000.

Basic type

The basic versions of PSS u2 modules are called base type modules (e.g. PSS u2 EF 8DI).

R-type

PSS u2 modules that are suitable for use with increased environmental requirements and railway applications are called R-type modules (e.g. PSS u2 EF 8DI **-R**).

1.4 Definition of symbols

Information that is particularly important is identified as follows:

DANGER!

This warning must be heeded! It warns of a hazardous situation that poses an immediate threat of serious injury and death and indicates preventive measures that can be taken.

WARNING!

This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.

CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.

NOTICE

This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.

INFORMATION

This gives advice on applications and provides information on special features.

2 Overview

Module structure:

A module consists of

- an electronic module,
- a terminal block with cage clamp terminals and
- a module carrier

The electronic modules are plugged into the backplane and determine the function. The backplane is used for communication between the head module and the electronic modules and forms the carrier unit for the electronic modules. The terminal block is plugged into the electronic modules and is used to connect the field wiring.

Details of the terminal blocks that can be used are available under "Intended Use".

2.1 Module features

Application of the product PSS u2 EF 2AI I (-R):

Electronic module with analogue inputs for failsafe applications

- 2 analogue inputs for current measurement
- Each input can be configured separately
- Resolution: 15 bit
- Current limitation per input
- Measuring range 0 … 25.6 mA
- Data format [📖 30]
  - 16-bit two's complement
  - 15-bit sign and magnitude representation + sign bit (MSB)

    (can only be configured in the remote I/O system PSS u2)
- Scaling [📖 23]
- Moving averaging [📖 22]
- Working range monitoring [📖 21]
- Range monitoring [📖 25]
- Threshold value monitoring [📖 26]
- Plausibility check [📖 28]
- 2 Voltage outputs
- Current load capacity per output: 0,5 A
  - Short circuit proof
  - Overload-proof
- LED displays for:
  - Operating status per input
  - Module error

INFORMATION

HART communication

Due to the module's high cutoff frequency of 1540 Hz, the HART protocol cannot be completely filtered by the input filter.

- **R-type**:
  for increased environmental requirements and railway applications

2.2 Side view right-hand

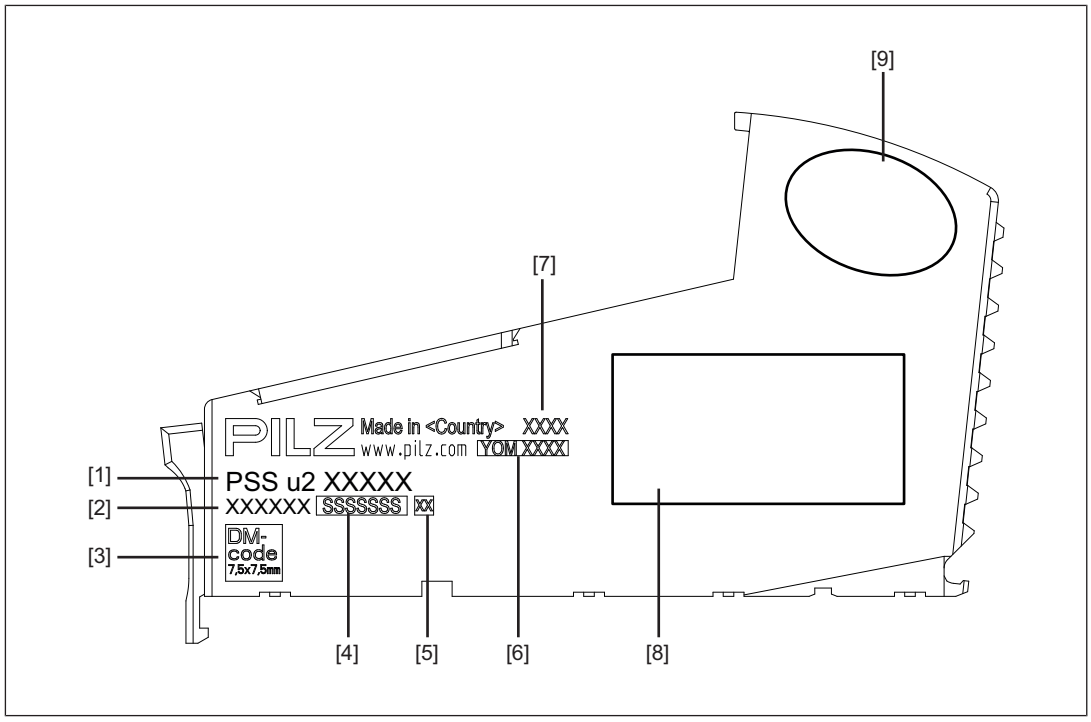


Fig.: Electronic module without terminal block, side view

Legend

[1]	Product Name
[2]	Order number
[3]	2D code product information
[4]	Serial number
[5]	Hardware version
[6]	"YOM" year of manufacture
[7]	Production site
[8]	Placeholder for block diagram
[9]	Placeholder for approval tags

3 Safety

3.1 Intended use

INFORMATION

If the module name is not explicitly named, the details apply to all the variants of the module.

Use in a PSS u2 system

The module PSS u2 EF 2AI I may be used in the following PSS u2 systems (see Terminology [📖 5]):

- Remote I/O system PSS u2
- PSS u2 in the automation system PSS 4000 (generation 2)

The module PSS u2 EF 2AI I -R may be used in the following PSS u2 system (see Terminology [📖 5]):

- PSS u2 in the automation system PSS 4000 (2nd generation)

The module/backplane/safety controller should be installed in a protected environment, see documents:

- Installation Manual PSS u2 in the automation system PSS 4000 (1006253), under "Installation in a protected space"
- Installation Manual Remote I/O system PSS u2 (1004152), under "Installation in a protected space"

Make sure that only authorised personnel have access to the products.

Configuration and user program

Please note the following during configuration and within the user program:

- Evaluate the valid bits for the inputs in the user program.
- With 1-channel operation, perform cyclical tests with a measured value to be expected which is at least as high as the maximum safely detected measured value. These cyclical tests are used to detect measurement errors and offset errors of the sensor and module errors.
  If the maximum safely detected measured value is < 10 mA, run the cyclical tests with at least 10 mA.
- With 1-channel and 2-channel operation, use sensors that at least meet the requirements of EN IEC 62061: SIL 2 and detect any deviation of the actual currents from the set currents.
- With 2-channel operation, perform a cyclical plausibility check of the measurement values of the two inputs (see chapter Plausibility check [📖 28]). Take appropriate measures to avoid common cause errors in the sensor technology, by using diverse sensors or a separate supply voltage for the sensors, for example.

- Monitor a defined working range to detect sensor errors, open circuits, high impedance terminal points or short circuits. Typically, this is the working range 4 ... 20 mA. Please also read the information and recommendations in chapter Working range monitoring [📖 21].
  The lower working range limit must not exceed 2 mA.
- The measured value is attenuated through the input filter. At the cutoff frequency, the amplitude of the measured value is 70 % of the amplitude of the input signal.
- When (re)commissioning after a change the entire safety function must be tested. This requirement also applies for recommissioning after prolonged interruption and errors, in particular after unintended operation of the inputs with voltages that are too high and/or with reverse polarity.

CAUTION!

Destruction of the device by not permitted voltages at the inputs

No voltages higher than 30 V must be applied at the inputs. Failure to comply with this requirement could destroy the device.

Failsafe applications

The module may be used for failsafe applications.

Failsafe inputs

The module has failsafe inputs.

The analogue FS inputs meets the requirements of EN IEC 62061: SIL 2.

Application areas

- Use on machinery and in industrial environments (2006/42/EU and 2023/1230/ EU)
  The modules PSS u2 EF 2AI I (-R) meet the **safety-related** requirements of EN IEC 61508, EN 62061, EN ISO 13849-1, EN 61131, EN 13851 and EN 16092, categories up to max. SIL 3 or up to max. PL e (see Technical details [📖 50]).
- Use in railway applications (CENELEC)

  Depending on the selected railway architecture (see Safety Manual, under Safety architectures for railway applications (1006614)), the module PSS u2 EF 2AI I -R meets the **safety-related** requirements of EN 50126, EN 50129, EN 50159, EN 50716 and EN 45545, category up to max. SIL 4 (see Technical details [📖 50]).

  Only R-type modules may be used in a PSS u2 system for railway applications.

- Increased environmental requirements

  The module PSS u2 EF 2AI I -R is suitable for use where there are increased environmental requirements (see Technical details [📖 50]).

  Only R-type modules may be used in a PSS u2 system in applications with increased environmental requirements.

- Use in lifts and on escalators (2014/33/EU)
  The modules PSS u2 EF 2AI I (-R) can be used as a PESSRAL (programmable electronic system in safety-related applications for lifts) in accordance with the Lifts Directive 2014/33/EU. The modules meet the requirements in accordance with EN 81-20, EN 81-22, EN 81-50 for passenger and goods lifts, as well as the requirements in accordance with EN 115-1 for escalators and moving walks (see Technical details [📖 50]).
- Use in combustion plants (2015/2193/EU)
  The modules PSS u2 EF 2AI I (-R) can be used in combustion plants and meet the **safety-related** requirements of EN 298, EN 1643, EN 13611 and EN 50156 (see Technical details [📖 50]).

Operating height

With reference to the standard IEC 61131-2 the values stated in the technical details for ambient temperature are reduced at heights >2000 m operating height above sea level (see Supplementary data [📖 55]).

EMC-compliant installation

Intended use includes making the electrical installation EMC-compliant. Please refer to the guidelines stated in the relevant installation manuals (see Additional documents that apply [📖 13]).

Improper use

The following is deemed improper use in particular

- Any component, technical or electrical modification to the module,
- Use of the module outside the areas described in this operating manual,
- Any use of the module that is not in accordance with the technical details.

Software tools

The module PSS u2 EF 2AI I is supported by:

- PASconfig from Version 5.1.2
- PAS4000 from Version 1.29.0

The module PSS u2 EF 2AI I **-R** is supported by:

- PAS4000 from Version 1.29.0

INFORMATION

We recommend that you always use the latest version of the software tool (download from www.pilz.com).

Backplane

The module PSS u2 EF 2AI I may be installed on the following backplanes:

- PSS u2 B 1
- PSS u2 B 4

The module PSS u2 EF 2AI I **-R** may be installed on the following backplanes:

- PSS u2 B 1 -R
- PSS u2 B 4 -R

Terminal blocks

The module PSS u2 EF 2AI I (-R) may be used in conjunction with the following terminal block:

- 16-pin terminal block

3.1.1 Third-party manufacturer licence information

This product includes Open Source software with various licenses.

Further information is available in the document "Third-party manufacturer licence information PSS u2 EF 2AI I (-R)/PSS u2 EF 2AI U (-R) (document number 1006301) at www.pilz.com.

3.2 Safety regulations

3.2.1 Additional documents that apply

Please read and take note of the following documents:

- Installation Manual remote I/O system PSS u2 (1004152)
- Installation Manual PSS u2 in the automation system PSS 4000 (1006253)
- System Description PSS 4000 (1001467)
- Safety Manual PSS 4000 (1001468)

With railway applications you should also refer to:

- Safety Manual, Safety Architectures for Railway Applications (1006614)

You will need to be conversant with the information in these documents in order to fully understand this operating manual.

3.2.2 Safety assessment in an industrial environment

Before using a device, a safety assessment in accordance with the Machinery Directive is required.

The product as an individual component fulfils the functional safety requirements in accordance with EN ISO 13849 and EN IEC 62061. However, this does not guarantee the functional safety of the overall plant/machine. To achieve the relevant safety level of the overall plant/machine's required safety functions, each safety function needs to be considered separately.

3.2.3 Safety assessment in railway applications (PSS u2 in the automation system PSS 4000)

Before using a device, a safety assessment with risk assessment and risk analysis is required.

Using the architectures defined in the safety manual "Safety architectures for railway applications", the product fulfils the functional safety requirements in accordance with EN 50126/EN 50129. However, this does not guarantee the functional safety of the overall railway application/plant. To achieve the relevant safety level of the overall railway application's/plant's required safety function, each safety function needs to be considered separately.

3.2.4 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, decommissioned and maintained by persons who are competent to do so.

A competent person is a qualified and knowledgeable person who, because of their training, experience and current professional activity, has the specialist knowledge required. In order to inspect, assess and handle products, devices, systems, plant and machinery, this person must be familiar with the state of the art and the applicable national, European and international laws, directives and standards.

It is the company's responsibility only to employ personnel who

- Are familiar with the basic regulations concerning health and safety / accident prevention,

- Have read and understood the section on "Safety" in this description and
- Have a good knowledge of the generic and specialist standards applicable to the specific application.

3.2.5 Warranty and liability

All claims to warranty and liability will be rendered invalid if

- The product was used contrary to the purpose for which it is intended,
- Damage can be attributed to not having followed the guidelines in the manual,
- Operating personnel are not suitably qualified,
- Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

3.2.6 Disposal

- In safety-related applications, please comply with the mission time T_M stated in the safety-related characteristic data.
- When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

4 Security

To protect plants, systems, machines and networks against cyberthreats it is necessary to implement (and continuously maintain) an overall Industrial Security concept that is state of the art.
Carry out a risk assessment in accordance with VDI/VDE 2182 or IEC 62443-3-2 and plan the security measures with care.

If you have any questions about implementation, please contact technical support at support@pilz.com.

You can reach the Pilz Product Security Incident Response Team (PSIRT) at https://www.pilz.com/psirt.
With regard to a Pilz product, this is where you can:

- Report security vulnerabilities and security incidents
- Ask questions about security vulnerabilities and security incidents
- View Security Advisories

4.1 Security (remote I/O system PSS u2)

Further information on Security can be found in the operating manuals of the relevant head modules.

4.2 Security (PSS u2 in the automation system PSS 4000)

Further information on Security can be found in the system description PSS 4000 (1001467).

5 Function description

5.1 Block diagram

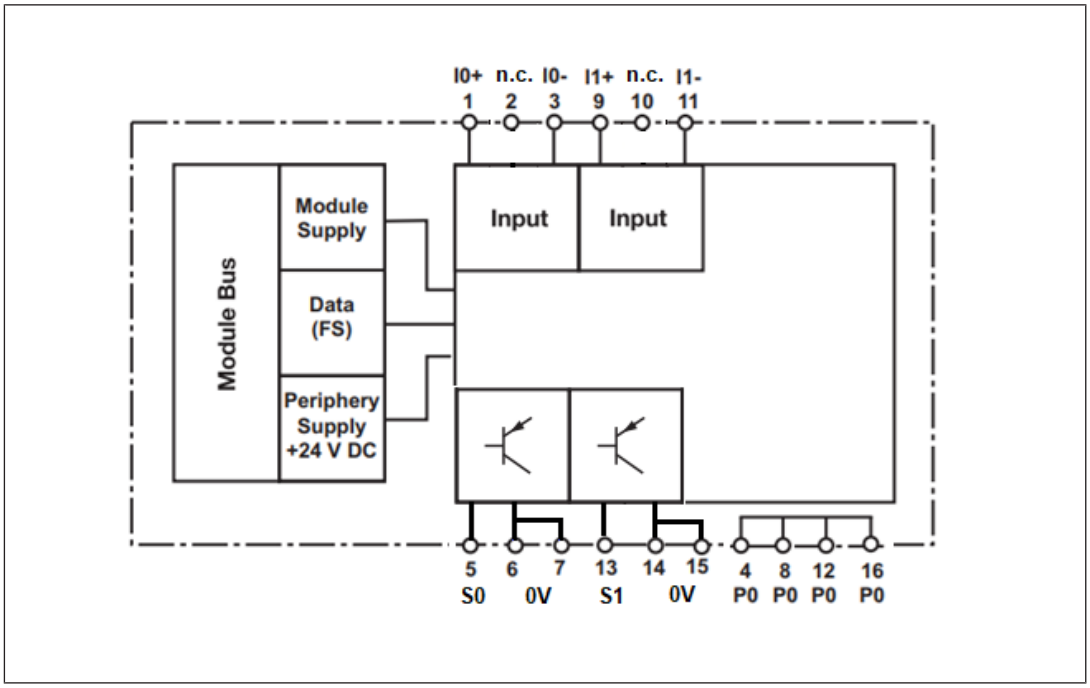


Fig.: Block diagram PSS u2 EF 2AI I (-R)

5.2 Supply

- The module is supplied with voltage via the head module/main voltage supply module PSS u2 PSx (-R) connected to the head module.

5.3 Integrated protection mechanisms

The module provides the following diagnostic data:

- Start-up error
- Configuration error
- FS communication error
- Temperature error: too warm, too hot
- Over- and undervoltage
- Periphery's supply voltage (periphery supply) is monitored
- Overload and short circuit of the sensor supply lines

5.3.1 Measures for achieving process safety

The module will detect internal module errors. Sensor errors and wiring errors can be detected using the configuration of limit values.

Please note that the overall accuracy must be considered when defining monitored limit values in the user program. The calculation of the overall accuracy is described in the following examples

Example for calculating the overall measuring accuracy with 1-channel operation

Example for the module PSS u2 EF 2AI I

The overall accuracy in % is calculated by adding the following values:

- Module's safety-related accuracy of **2.5 %** (see Technical details [📖 50]).
- Module's measuring accuracy

  This value results from the addition of all the deviations from the measuring range end value (see Technical details [📖 50]).

  A measuring accuracy of **0.7 %** is assumed for this example.
- Sensor's measuring accuracy

  This value is taken from the sensor's technical details.
  A measurement accuracy of **0.5 %** is assumed for this example (in relation to the overall measuring range of the sensor).

Calculation of the monitored limit values, taking into account the overall accuracy:

- Overall accuracy in **%**:
  2.5 % + 0.7 % + 0.5 % **= 3.7 %**.
  The overall accuracy refers to the overall measuring range of 0 ... 25.6 mA
- Overall accuracy in **mA** in relation to the overall measuring range:
  25.6 mA * 3.7 % = **0.947 mA**
- Measuring range of the sensors: 0 ... 100 °C at 4 ... 20 mA.
  Resolution of the sensor: 100 °C / (20 – 4 mA) = **6.25 °C per mA**.

The overall accuracy in °C is therefore: 0.947 mA * 6.25 °C per mA = **5.92 °C**.

This overall accuracy must be considered when defining monitored limit values in the user program.
For example, if a hazardous situation should arise at a temperature above 80 °C, a safe reaction must occur in the user program at a temperature above 80 °C - 5.92 °C = 74.08 °C.

Further information on the measuring range of the sensor is available at Scaling [23] and on the area and threshold value monitoring at Range monitoring [25] and Threshold value monitoring [26].

Example for calculating the overall measuring accuracy with 2-channel operation

Example for the module PSS u2 EF 2AI I

With 2-channel operation, both inputs and two sensors must be used, as well as the Plausibility check [28] function.

The overall accuracy in % is calculated by adding the following values:

- Module's safety-related accuracy of **2.5 %** (see Technical details [50]).
- Empirically established tolerance
  in the Pilz software tool in the module properties, under ***plausibility check***, enter a tolerance amount and a tolerance time at which availability is still maintained.

  This tolerance defines the maximum permitted deviation between the two analogue input signals. With this tolerance, the measuring accuracy of the module and the sensors must be considered.

  In the example, a tolerance of **2 %** has been determined.

  If a set tolerance is exceeded, the analogue value is signalled as invalid. For availability reasons, we therefore recommend that you use a slightly higher value for the tolerance than the empirically established deviation.
  For the example, a tolerance of **3 %** was therefore set for the plausibility check.
- Module's measuring accuracy

  This value results from the addition of all the deviations from the measuring range end value (see Technical details [50]).

  A measuring accuracy of **0.7 %** is assumed for this example.
- Measuring accuracy of the sensors

  From the technical details of the sensors, the value of the sensor with the greatest measuring deviation must be used. Use only this value.

  A value of **0.5 %** is assumed for this example (in relation to the overall measuring range of the sensor).

Calculation of the monitored limit values, taking into account the overall accuracy:

- Overall accuracy in **%**:
  2.5 % + 3 % + 0.7 % + 0.5 % **= 6.7** %.
  The overall accuracy refers to the overall measuring range of 0 ... 25.6 mA

  Note: The overall accuracy can be improved by using the average value of the two input values in the application. In this case, the tolerance amount determined for the plausibility check is included only by half in the overall accuracy.
- Overall accuracy in **mA** in relation to the overall measuring range:
  25.6 mA * 6.7 % = **1.715 mA**
- Measuring range of the sensor: 0 ... 500 Mbar at 4 ... 20 mA.
  Resolution of the sensor : 500 mbar / (20 – 4 mA) = **31.25 mbar per mA**.

The overall accuracy in mbar is therefore: 1.715 mA * 31.25 mbar per mA = **53.6 mbar**.

This overall accuracy must be considered when defining monitored limit values in the user program.
For example, if a hazardous situation should arise at a pressure above 300 mbar, a safe reaction must occur in the user program at a pressure above 300 mbar – 53.6 mbar = 246.4 mbar.

WARNING!

Loss of the safety function by limit values that have been set too high or too low!

You must take into account the overall accuracy when setting the limit values in the user program.

5.4 Signal processing

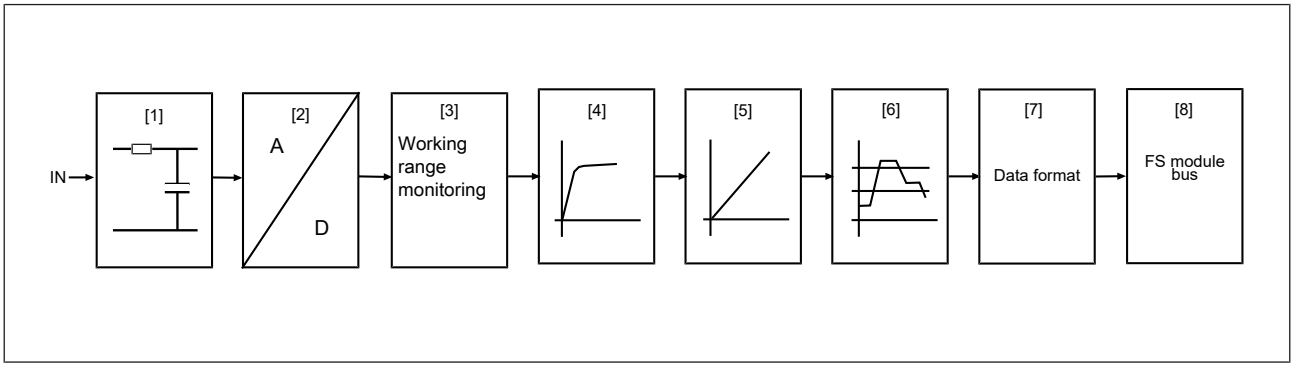


Fig.: Schematic representation of signal processing

- [1] Input filter

  The analogue value is read in and prefiltered.
- [2] A/D converter

  The analogue value is converted into digital signals with a 15-bit resolution (32 767 steps).
- [3] Working range monitoring

  Working range monitoring can be activated for the digital signal in order to detect wiring faults.
- [4] Moving averaging

  A digital filter can be activated for the digital signal.
- [5] Scaling

  The digital signal can be scaled to a 16-bit value.
- [6] Range and threshold value monitoring and plausibility check

  The digital signal can be monitored to check if ranges and threshold values have been exceeded. Between two inputs a plausibility check can be performed. The inputs are monitored for the exceeding of a difference between analogue input value 0 and analogue input value 1 over a specified period (plausibility check).
- [7] Data format

The data format enables the scaled value to be represented as a two's complement or as sign and magnitude (only in the remote I/O system PSS u2).

- [8] FS module bus

  The input signals are transmitted to the head module via the FS module bus. As an option the input module can send status information for each input. All the configuration data is stored in the head module and is assigned to the input module on restart. This way the configuration data is retained even if you change the input module.

INFORMATION

Depending on the application, various settings and values can be configured in the Pilz software tool.

You can configure the settings and values in the module's properties. An overview can be found under Summary of configuration options [📖 32].

5.5 Measuring range

The module has a measuring range of 0 … 25.6 mA. The module is suitable for connecting sensors with a current output that lies inside the measuring range.

If the value moves outside the measuring range, the valid bit of the corresponding input in the user program is set to 0 and an error message is issued.

- Use in the PSS u2 automation system PSS 4000

  The measured positive or negative maximum value is set to zero.

- Use in the remote I/O system PSS u2

  The measured positive or negative maximum value will continue to be registered in the user program as the scaled digital value.

Negative measured values up to - 0.1 mA (-128_D) are tolerated so that an error message is not issued for unwired terminals.

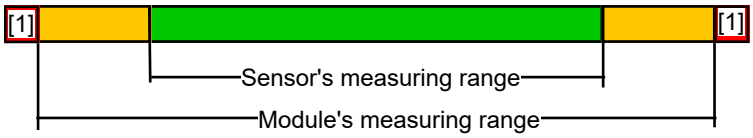


Fig.: Relationship between the module's measuring range and the sensor's measuring range

Legend

[1]	Module's measuring range exceeded Valid bit = 0

5.6 Working range monitoring

The limits of the working range (valid measuring range) are configurable.

If you monitor the input value you can define a working range that is used to detect sensor faults or faults in the wiring, such as open circuit or short circuit. Monitoring works with the digitalised value before it is scaled. An error message is issued if the value moves outside the limit values. The fact that the values move outside the limit values will also be registered in the user program.

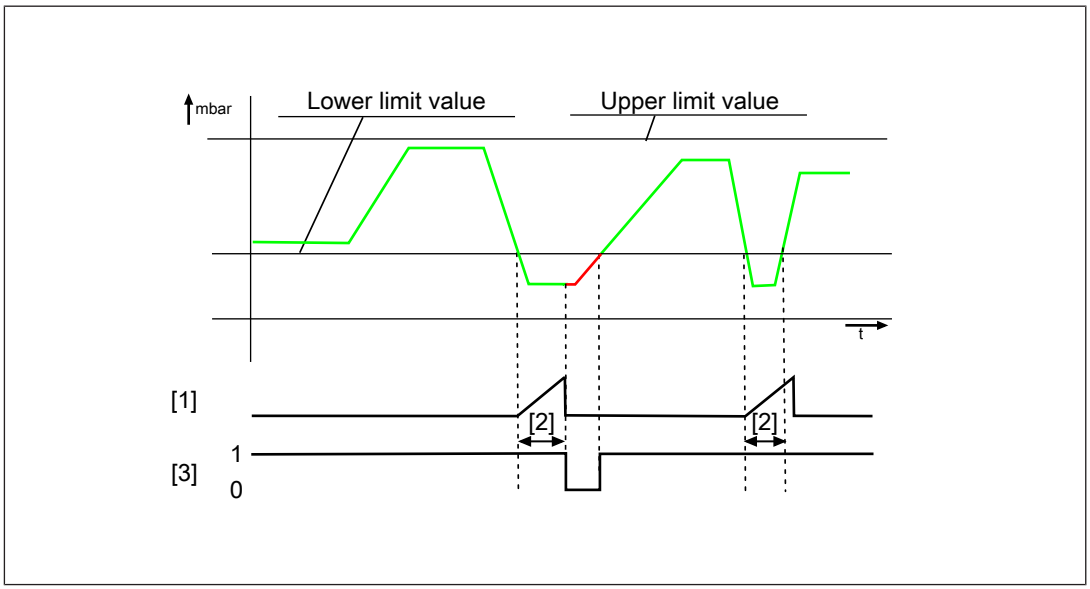


Fig.: Example of values moving outside the lower limit value

Legend

[1] Configurable time for which values outside the limit values will be tolerated.

[2] Tolerated configured time

[3] The fact that the values moved outside the limit values is registered in the user program.

Monitoring in accordance with NAMUR NE43

We recommend that you configure the limit values for which values outside the limit values will be tolerated, in accordance with NAMUR NE43.

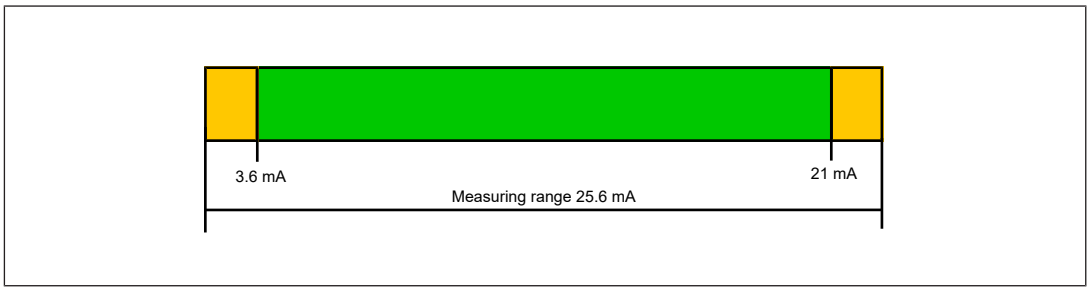


Fig.: Limit values in accordance with NAMUR NE43

If working range monitoring is activated, the following default values apply:

- **Lower limit value**: 4608_D (3.6 mA)
  (e.g. open circuit)

- **Upper limit value**: 26880_D (21 mA)
  (e.g. short circuit or transducer error)
- Period for which an overshoot and undershoot will be tolerated: 1 ms

The default settings are in accordance with NAMUR NE 43 recommendation to simplify the signal level for the failure information. We recommend compliance with NAMUR recommendation NE 43.

WARNING!

Potential loss of safety function if the working range monitoring is not used

It must be ensured that open circuits and sensor errors are detected. If you do not use working range monitoring, other suitable measures must be taken.

5.7 Moving averaging

A digital filter can suppress interference frequencies in the input signals. The filter is implemented by forming the moving average. When forming the moving average, the sum of the latest sampled results is used to calculate an average. The module has a cycle time of 0.1 ms. With a cycle time of 0.1 ms, the input signal is sampled with a frequency of 10 kHz. The number of sampled results and the period over which the average is calculated is configurable in the following steps:

- 0.1 ms (no filtering)
- 0.2 ms
- 0.5 ms
- Default setting 1 ms
- 2 ms
- 5 ms
- 10 ms
- 16.7 ms, for attenuation of 60 Hz mains interference
- 20 ms, for attenuation of 50 Hz mains interference

Special features and examples:

- 0.1 ms

  The moving average is calculated over 1 cycle time. There is no averaging. The result corresponds to the sampled value.
- 0.2 ms

  The moving average is calculated over 2 cycle times.
- 0.5 ms

  The moving average is calculated over 5 cycle times.
- 1 ms

  The moving average is calculated over 10 cycle times.
- 2 ms

The moving average is calculated over 20 cycle times.

- 5 ms

  The moving average is calculated over 50 cycle times.

- 10 ms

  The moving average is calculated over 100 cycle times.

- 16.7 ms

  The moving average is calculated over 167 cycle times.

  This setting includes interference frequency suppression of 60 Hz.

- 20 ms

  The moving average is calculated over 200 cycle times.

  This setting includes interference frequency suppression of 50 Hz.

INFORMATION

A filter always results in attenuation and a delay of the (input) signal.

5.8 Scaling

The scaling function can be used to convert the digitalised measured value (Input) into a scaled digital value (ScaledValue). The digitalised measured value (Input) corresponds to the filtered value (see Signal processing [19]). The scaled digital value is represented with a 16-bit resolution (-32768_D … 32767_D) and is registered in the process image (see Structure of the process image). The default values are selected to give a scaling with gradient **m** of 1 and an offset (y axis intercept) of 0.

Scaling can only be used with linear input variables.

- The digitalised measured value (Input) is scaled over a two-point characteristic.
- The two points are configured as follows:
  - Lower limit value of the measuring range (MeasuringLow): Point 1 on the X-axis
  - Upper limit value of the measuring range (MeasuringHigh): Point 2 on the X-axis
  - Lower limit value of the scaled range (ScaledLow): Point 1 on the Y-axis
  - Upper limit value of the scaled range (ScaledHigh): Point 2 on the Y-axis
  - In order not to limit the measuring range, we recommend you select two end points on a straight line, which include the whole measuring range to be scaled.
- Error reactions:
  - If MeasuringLow = MeasuringHigh, then the calculation of the scaled digital value will result in a division by zero. The terminal LEDs belonging to the input flash green and the status LED flashes red. The input valid bits are set to "0" and a diagnostic message is entered in the error stack. The scaled value (ScaledValue) is set to "0".
  - If MeasuringLow < MeasuringHigh and Input < MeasuringLow, then ScaledValue = ScaledLow
  - If MeasuringLow < MeasuringHigh and Input > MeasuringHigh, then ScaledValue = ScaledHigh

– If MeasuringLow > MeasuringHigh and Input > MeasuringLow, then ScaledValue = ScaledLow
– If MeasuringLow > MeasuringHigh and Input < MeasuringHigh, then ScaledValue = ScaledHigh
– If the digitalised measured value (input) leaves the configured measuring range, there is no error message and the LEDs do not flash.

  Exceeding the configured measuring range is signalled in the process image (PII) (e.g. via a special status bit).

  The value ScaledLow or ScaledHigh is transmitted to the head module, depending on whether the upper or lower limit has been exceeded.

  The LEDs on the module status display and the terminal status display remain green, as there is no error.

Calculating the scaled digital value (ScaledValue) from the digitalised measured value (Input):

ScaledValue = ScaledLow + [((Input - MeasuringLow)*(ScaledHigh - ScaledLow)) / (MeasuringHigh - MeasuringLow)]

▸ The value ScaledValue is available as a scaled digital value in the user program.

Example:

In this example, a pressure of 0 to 10,000 mbar is monitored.

MeasuringLow	Lower limit value of the measuring range	4608_D
MeasuringHigh	Upper limit value of the measuring range	26880_D
ScaledLow	Lower limit value of the scaled range	0 bar
ScaledHigh	Upper limit value of the scaled range	10000 mbar
Input	Value to be scaled	12800_D

▸ **Scaled digital value:**

ScaledValue = ScaledLow + [((Input - MeasuringLow) * (ScaledHigh - ScaledLow)) / (MeasuringHigh - MeasuringLow) = 0 mbar + [((12800_D - 4608_D) * (10000 mbar - 0 mbar)) / (26880_D - 4608_D)] = 3679_D mbar

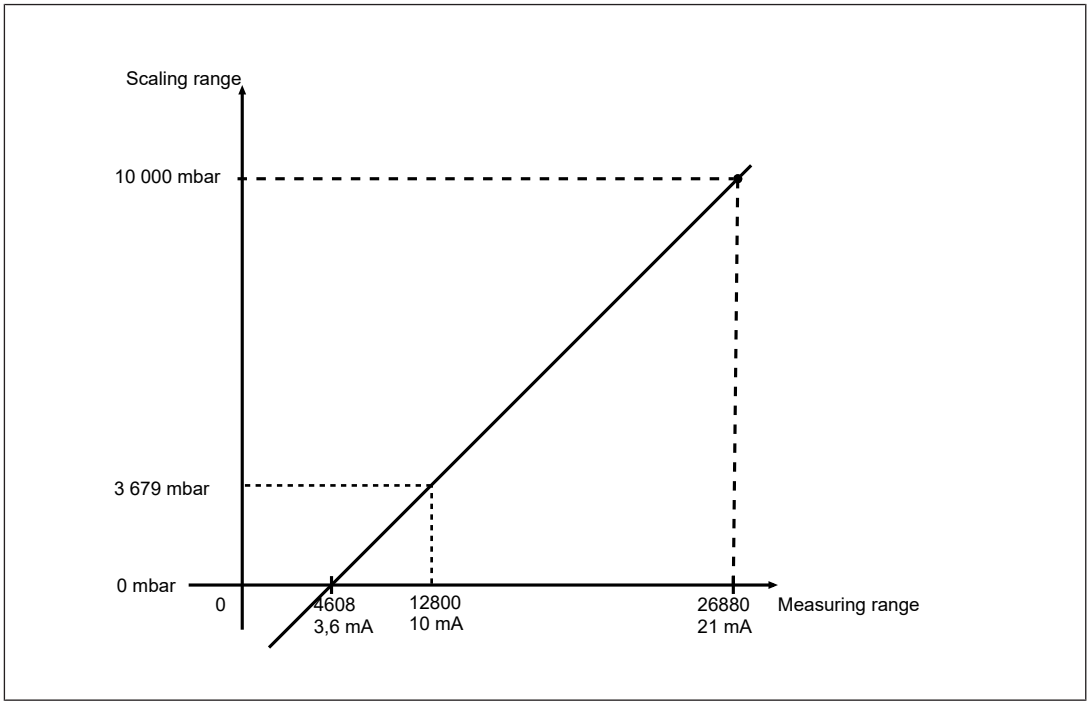


Fig.: Scaling

Legend

Scaling range	Scaled values
Measuring range	Measured current values

INFORMATION

Scaling may influence the accuracy of the digitalised measured value.

5.9 Range monitoring

Range monitoring works with the scaled digital value. Up to 4 individually configurable ranges can be monitored per input. Range monitoring compares the upper and lower limit value for each configured range with the digital value after scaling and registers the result of the comparison in the user program. If a value moves outside a range, the measured scaled digital value will continue to be registered in the process image.

The result is "1" when the following condition is met:

- Configured lower limit value <= Scaled digital value <= Configured upper limit value

If the scaled digital value is outside a range's lower or upper limit value, then the result for this range will be "0".

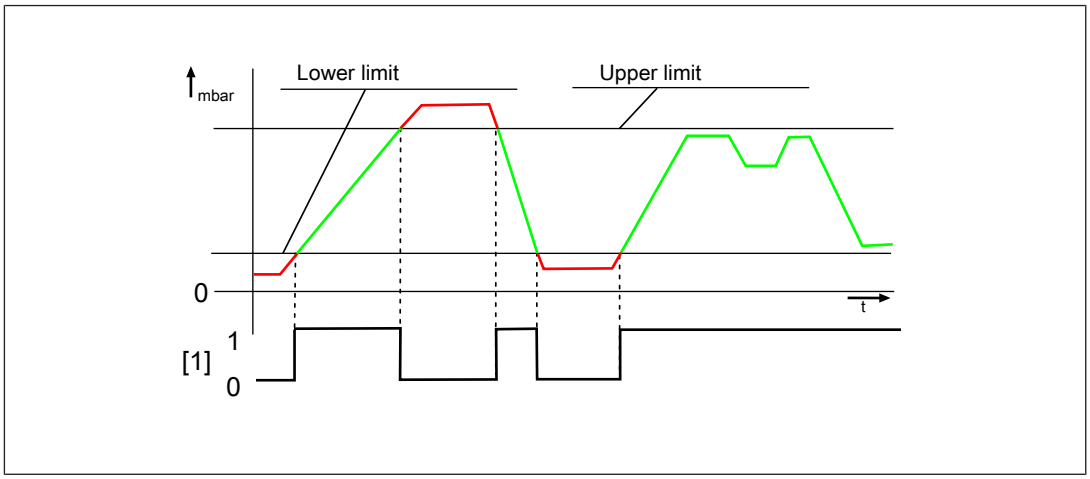


Fig.: Range monitoring

Legend

[1] Evaluation of range monitoring in the user program

Example:

In this example, the scaled values from 0 to 10,000 mbar from the Scaling [📖 23] chapter are to be used. If the pressure falls below 2,000 mbar or exceeds 8,000 mbar, the fact that the range has been exceeded is to be registered in the user program.

Configuration:

Lower limit value: 2,000 mbar

Upper limit value: 8,000 mbar

5.10 Threshold value monitoring

8 thresholds per input can be defined; these can be used to monitor the scaled signal. As a result, various warning and fault levels can be set up when monitoring physical values, for example.

Each threshold consists of a lower and an upper threshold value. The result of monitoring is registered in the user program. For each threshold it is possible to configure whether to register in the user program that the value has exceeded the upper threshold value or fallen below the lower threshold value.

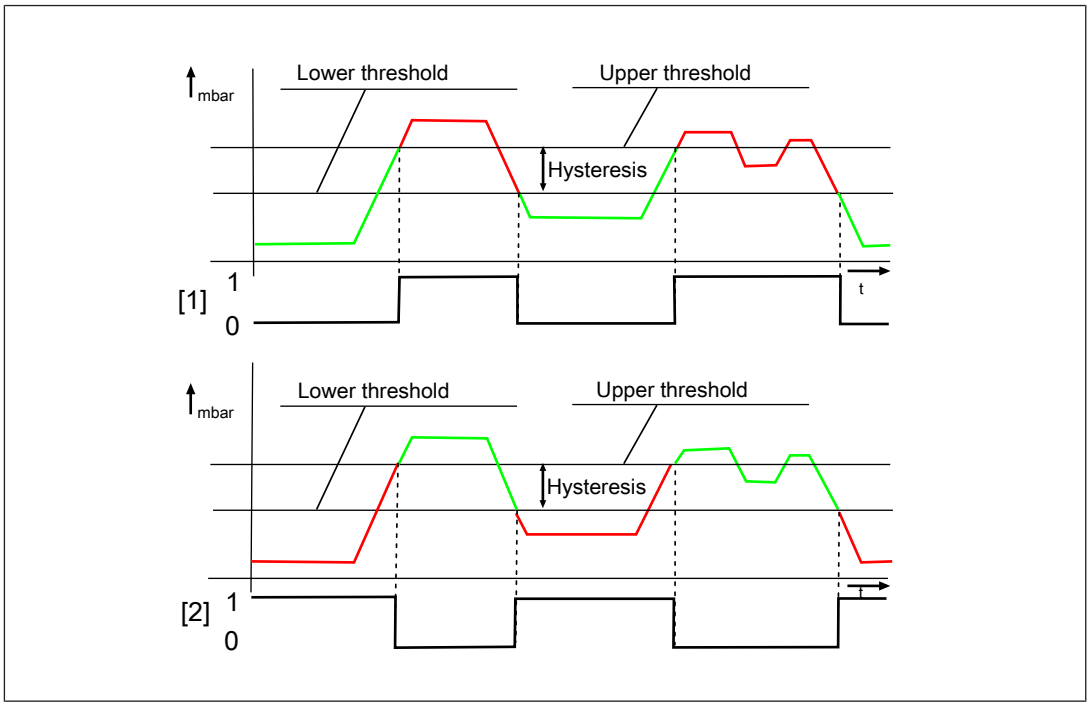


Fig.: Threshold value monitoring

Legend

[1] Configuration-dependent evaluation of the threshold value in the user program, monitored for values above the limit:

- Bit is set when the value has exceeded the upper threshold value.
- Bit is reset when the value falls below the lower threshold value.

[2] Configuration-dependent evaluation of the threshold value in the user program, monitored for values below the limit:

- Bit is set when the value falls below the lower threshold value.
- Bit is reset when the value exceeds the upper threshold value.

Example:

The scaled values from 0 to 10,000 mbar under Scaling [📖 23] are to be used in this example. If the pressure of 8,000 mbar is exceeded, the fact that the threshold value has been exceeded is to be registered in the user program.

Configuration for a hysteresis of 100 mbar:

Upper threshold value: 8,000 mbar

Lower threshold value: 7,900 mbar

5.11 Plausibility check

The plausibility check is used to check whether the difference between the two scaled input signals of an electronic module exceeds a configured tolerance amount for longer than a configured tolerance time (t1). The permitted tolerance amount of the two input signals and the permitted tolerance time (t1) are configurable.

Default values:

- Tolerance amount:

  200_D

- Tolerance time (t1):

  100 µs.

- The result of the comparison is reported in the process image (see "Structure of the process image (remote I/O system PSS u2)"/"I/O data of the module (PSS u2 in the automation system PSS 4000)").

If the difference between the two inputs signals does not exceed the configured tolerance amount for the duration of the configured tolerance time (t1), then the result for the comparison is reported as "1" in the user program.

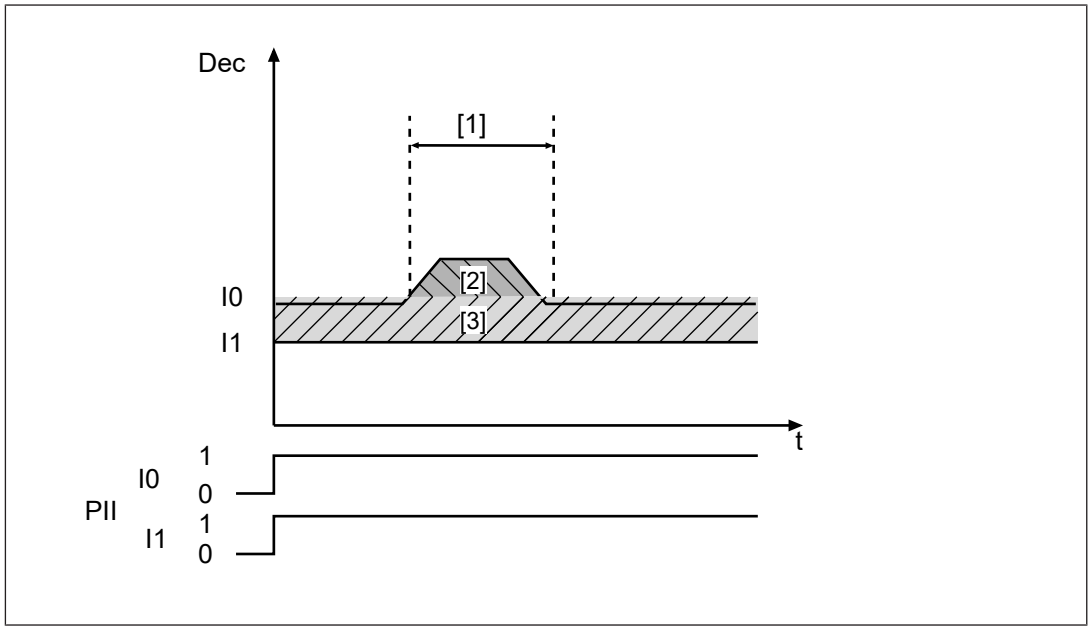


Fig.: Input signals within the tolerances

Legend

[1]	Configurable tolerance time t1 (0.1 … 6553.5 ms) Period for which an exceeded tolerance amount is tolerated
[2]	Tolerance amount exceeded, but within the tolerance time (t1)
[3]	Configured tolerance amount (0 … 65534) Amount by which the scaled input signals may differ
PII (I0, I1)	"Plausibility check" bits in the process image of inputs (PII)
I0 I1	Signals at input I0 and I1

If the difference between the two inputs signals exceeds the configured amount for longer than the duration of the configured time (t1), then the result for the comparison is reported as "0" in the user program. Once the amount is no longer exceeded, a "1" will again be reported in the process image.

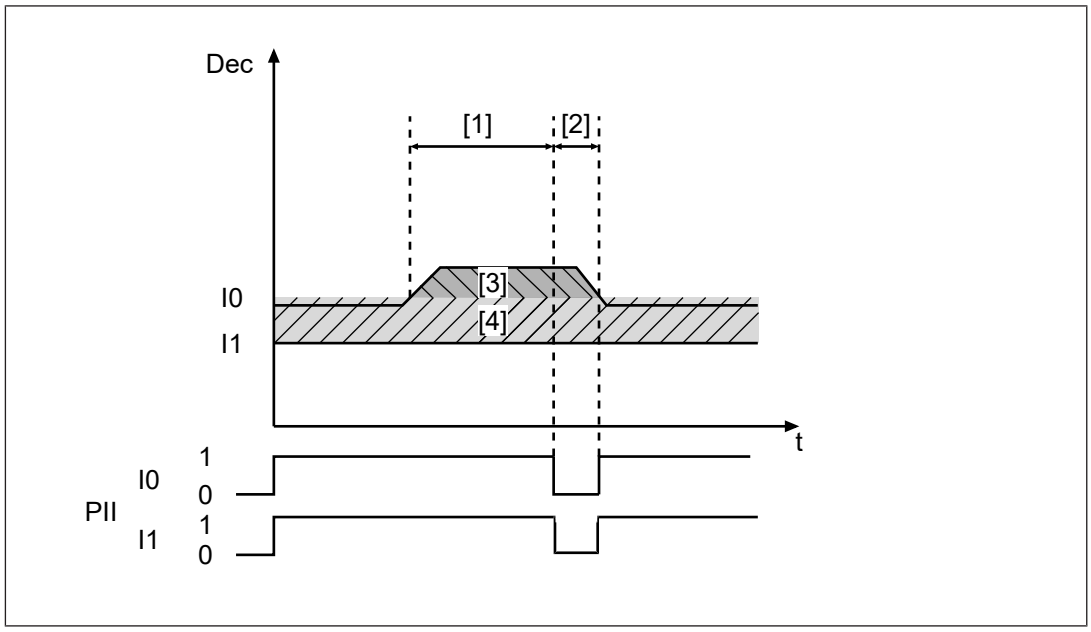


Fig.: Input signal I0 exceeds the tolerance time (t1)

Legend

[1]	Configurable tolerance time t1 (0.1 … 6553.5 ms) Period for which an exceeded tolerance amount is tolerated
[2]	Signal at input I0 is outside the tolerance amount for longer than the configured tolerance time
[3]	Tolerance amount exceeded
[4]	Configured tolerance amount (0 … 65534) Amount by which the scaled input signals may differ
PII (I0, I1)	"Plausibility check" bits in the process image of inputs (PII). The PII reports a "0" for the period during which the value is exceeded.
I0 I1	Signals at input I0 and I1

5.12 Data format

The data format enables the scaled digital value to be represented as:

- Two's complement (default data format)

  The scaled digital values are transferred with 16 bits.

- Sign and magnitude representation (only remote I/O system PSS u2)

  The scaled digital values are transferred with 15 bits plus a sign bit (MSB). The MSB is "1" with negative values and "0" with positive values.

Sign and magnitude representation and two's complement representation differ only on negative values.

Analogue value in a two's complement with default values for scaling:

Analogue value -0.1 mA … 25.6 mA	Binary	Hexadecimal	Decimal
25.59921875 mA (25.6 mA – 1 LSB)	0111 1111 1111 1111	$7FFF_H$	32767
20.0 mA	0110 0100 0000 0000	6400_H	25600
17.5 mA	0101 0111 1000 0000	5780_H	22400
15.0 mA	0100 1011 0000 0000	$4B00_H$	19200
12.5 mA	0011 1110 1000 0000	$3E80_H$	16000
10.0 mA	0011 0010 0000 0000	3200_H	12800
7.5 mA	0010 0101 1000 0000	2580_H	9600
5.0 mA	0001 1001 0000 0000	1900_H	6400
2.5 mA	0000 1100 1000 0000	$0C80_H$	3200
1.0 mA	0000 0101 0000 0000	0500_H	1280
0.1 mA	0000 0000 1000 0000	0080_H	128
50 µA	0000 0000 0100 0000	0040_H	64
25 µA	0000 0000 0010 0000	0020_H	32
12.5 µA	0000 0000 0001 0000	0010_H	16
6.25 µA	0000 0000 0000 1000	0008_H	8
3.125 µA	0000 0000 0000 0100	0004_H	4
1.5625 µA	0000 0000 0000 0010	0002_H	2
0.78125 µA	0000 0000 0000 0001	0001_H	1
0 A	0000 0000 0000 0000	0000_H	0
-0.1 mA	1111 1111 1000 0000	$FF80_H$	-128

Analogue value in a sign and magnitude representation with default values for scaling:

(Sign and magnitude representation can only be configured in the remote I/O system PSS u2. The default data format is always two's complement.)

Analogue value -0.1 mA … 25.6 mA	Binary	Hexadecimal	Decimal
25.59921875 mA (25.6 mA – 1 LSB)	0111 1111 1111 1111	$7FFF_H$	32767
20.0 mA	0110 0100 0000 0000	6400_H	25600
17.5 mA	0101 0111 1000 0000	5780_H	22400
15.0 mA	0100 1011 0000 0000	$4B00_H$	19200
12.5 mA	0011 1110 1000 0000	$3E80_H$	16000
10.0 mA	0011 0010 0000 0000	3200_H	12800
7.5 mA	0010 0101 1000 0000	2580_H	9600
5.0 mA	0001 1001 0000 0000	1900_H	6400
2.5 mA	0000 1100 1000 0000	$0C80_H$	3200
1.0 mA	0000 0101 0000 0000	0500_H	1280
0.1 mA	0000 0000 1000 0000	0080_H	128
50 µA	0000 0000 0100 0000	0040_H	64
25 µA	0000 0000 0010 0000	0020_H	32
12.5 µA	0000 0000 0001 0000	0010_H	16
6.25 µA	0000 0000 0000 1000	0008_H	8
3.125 µA	0000 0000 0000 0100	0004_H	4
1.5625 µA	0000 0000 0000 0010	0002_H	2
0.78125 µA	0000 0000 0000 0001	0001_H	1
0 A	0000 0000 0000 0000	0000_H	0
-0.1 mA	1000 0000 1000 0000	8080_H	-128

5.13 Summary of configuration options

The module has the following configuration options:

Configurable properties		Default value	Meaning
Plausibility check			
	Tolerance amount	200_D	Value by which the scaled input signals can deviate
	Tolerance time	100 µs	Period for which an exceeded tolerance amount is tolerated
I0(1,3): Measuring range			
	Measuring range	0 … +25.6 mA	
I0(1,3): Working range monitoring			
	Monitor working range	No	Deactivated
	Lower limit value (NAMUR NE43 = 4608)	4608_D	3.6 mA
	Upper limit value (NAMUR NE43 = 26880)	26880_D	21mA
	Timeout (NAMUR NE43 = 1)	1 ms	Period for which an overshoot or undershoot will be tolerated
I0(1,3): Filter with moving averaging			
	Time for averaging	1 ms	The filter is implemented by forming the moving average (see Moving averaging [📖 22])
I0(1,3): Scaling			
	Lower limit value of the measuring range	-128_D	Lower measuring range limit
	Upper limit value of the measuring range	32767_D	Upper measuring range limit
	Lower limit value of the scaled range	-128_D	Default value of the lower measuring range limit
	Upper limit value of the scaled range	32767_D	Default value of the upper measuring range limit
IO(1,3): Range monitoring Range 1			
	Lower limit value	-32768_D	Lower limit of the number range that can be represented
	Upper limit value	32767_D	Upper limit of number range that can be represented
IO(1,3): Threshold value monitoring Threshold 1			

Configurable properties		Default value	Meaning
	Lower threshold value	-32768_D	Lower limit of the number range that can be represented
	Upper threshold value	32767_D	Upper limit of number range that can be represented
	Operator for threshold monitoring	Value below the lower threshold value	Undershooting of the lower threshold value is signalled in the user program.
Data format		Two's complement	Two's complement is activated

5.14 Voltage outputs

- The periphery supply is available at the voltage outputs.
- The voltage outputs supply the sensors at the inputs.
- The voltage outputs are protected against overload and short circuit.

5.15 Reaction times

Signal propagation time without error

$t_{ProcIM\_wcd} = t_{Input\ filter} + t_{SW\ filter} + 0.2$ ms

t_{ProcIM_wcd}: Maximum processing time of the input module

$t_{Input\ filter}$: RC filter, 1. Order with cutoff frequency 1540 Hz

$t_{SW\ filter}$: configured software filter time (averaging)

Signal propagation time with error in single-channel operating mode

$t_{ProcIM\_ofd} = t_{Input\ filter} + t_{SW\ filter}$ + FS cycle time + 100 ms

t_{ProcIM_ofd}: Maximum processing time of the input module when an error occurs

Signal propagation time with error in dual-channel operating mode

If the configured tolerance time > 100 ms, the following formula applies:

$t_{ProcIM\_ofd} = t_{Input\ filter} + t_{SW\ filter}$ + FS cycle time + configured tolerance time

t_{ProcIM_ofd}: Maximum processing time of the input module when an error occurs

Tolerance time: Tolerance time of the plausibility check, during which two input signals are checked to ensure they do not exceed a set tolerance amount.

With a configured tolerance time of ≤ 100 ms, the formula under "Signal propagation time with error in single-channel operating mode" also applies to dual-channel operating mode.

5.16 Energy-saving functions

The energy levels are supported by the head module and are not configurable. The module supports the following energy levels:

– Switching off the LEDs that display the module and terminal status

– Switching off the LEDs that display the terminal status

6 Structure of the process image (Remote I/O system PSS u2)

When the electronic module is used in the remote I/O system, the data described below are available.

FS-PII

The module occupies 8 bytes in the process image of inputs.

Input	Byte	Bit	Meaning	Values
I0	0	0	Valid bit	1: Input value is valid 0: Input value is invalid
		1	Working range monitoring	1: Inside the range 0: Outside the range
		2	Plausibility check	1: Tolerance amount not exceeded or exceeded only within the tolerance time (t1) 0: Tolerance amount exceeded for longer then the duration of the tolerance time (t1)
		3	Value range monitoring of the scaled analogue input	1: Value to be scaled is outside the value range 0: Value to be scaled is inside the value range
		4	Range monitoring 0	1: Inside the defined range 0: Outside the defined range
		5	Range monitoring 1	1: Inside the defined range 0: Outside the defined range
		6	Range monitoring 2	1: Inside the defined range 0: Outside the defined range
		7	Range monitoring 3	1: Inside the defined range 0: Outside the defined range
	1	0 … 7	Threshold value monitoring Threshold 0 (Bit 0) to threshold 7 (Bit 7)	1: Exceeds or falls below threshold value 0: Does not exceed or fall below threshold value
	4, 5	0 … 15	Scaled input value	-32768 … 32767

Input	Byte	Bit	Meaning	Values
I1	2	0	Valid bit	1: Input value is valid 0: Input value is invalid
		1	Working range monitoring	1: Inside the range 0: Outside the range
		2	Plausibility check	1: Tolerance amount not exceeded or exceeded only within the tolerance time (t1) 0: Tolerance amount exceeded for longer then the duration of the tolerance time (t1)
		3	Value range monitoring of the scaled analogue input	1: Value to be scaled is outside the value range 0: Value to be scaled is inside the value range
		4	Range monitoring 0	1: Inside the defined range 0: Outside the defined range
		5	Range monitoring 1	1: Inside the defined range 0: Outside the defined range
		6	Range monitoring 2	1: Inside the defined range 0: Outside the defined range
		7	Range monitoring 3	1: Inside the defined range 0: Outside the defined range
	3	0 … 7	Threshold value monitoring Threshold 0 (Bit 0) to threshold 7 (Bit 7)	1: Exceeds or falls below threshold value 0: Does not exceed or fall below threshold value
	6, 7	0 … 15	Scaled input value	-32768 … 32767

7 I/O data of the module (PSS u2 in the automation system PSS 4000)

When the electronic module for PSS u2 is used in the automation system PSS 4000, the data described below are available.

7.1 Available I/O data in the I/O mapping

Data access is via pre-defined I/O data types:

I/O data name	I/O data type	Data element: Data type	Meaning	Values
I0(1,3) I1(9,11)	FS_I_AI2	Data: SAFEINT	Analogue, scaled input value (two's complement only)	-32768 … 32767
		NAMUR_NE43: SAFEBOOL	Working range monitoring	1: Inside the range 0: Outside the range
		Compare: SAFEBOOL	Plausibility check	1: Tolerance amount not exceeded or exceeded only within the tolerance time (t1) 0: Tolerance amount exceeded for longer then the duration of the tolerance time (t1)
		ScalingLimit: SAFEBOOL	Value range monitoring of the scaled analogue input	1: Value to be scaled is outside the value range 0: Value to be scaled is inside the value range
		Range0: SAFEBOOL	Range monitoring 0	1: Inside the defined range 0: Outside the defined range
		Range1: SAFEBOOL	Range monitoring 1	
		Range2: SAFEBOOL	Range monitoring 2	
		Range3: SAFEBOOL	Range monitoring 3	
		LimitValue0: SAFEBOOL	Threshold monitoring Threshold 0	1: Exceeds or falls below threshold value 0: Does not exceed or fall below threshold value
		LimitValue1: SAFEBOOL	Threshold monitoring Threshold 1	
		LimitValue2: SAFEBOOL	Threshold monitoring Threshold 2	
		LimitValue3: SAFEBOOL	Threshold monitoring Threshold 3	
		LimitValue4: SAFEBOOL	Threshold monitoring Threshold 4	
		LimitValue5: SAFEBOOL	Threshold monitoring Threshold 5	
		LimitValue6: SAFEBOOL	Threshold monitoring Threshold 6	
		LimitValue7: SAFEBOOL	Threshold monitoring Threshold 7	

7.2 Other I/O data

In addition to the I/O data available via I/O mapping, it is possible to access further I/O data in the user program:

- Valid bit of input I0
- Valid bit of input I1

The following applies to all valid bits:

- 1: Input value is valid
- 0: Input value is invalid

In the Multi programming, access is via the PSS 4000 system control block "Valid".

In IEC 61131 programming, access is via the variable extension "WITH VALID".

8 Installation

8.1 General installation guidelines

NOTICE

R-type electronic modules may only be installed on R-type backplanes.

CAUTION!

Risk of material damage

The incorrect ambient temperature during assembly/dismantling can lead to material damage.

– Comply with the permitted ambient temperature for assembly/dismantling: -20°C … +45°C

CAUTION!

Risk of material damage

Electrostatic discharge can damage components.

– Ensure against discharge before touching the product, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.

8.1.1 Dimensions

The dimensions include the backplane, electronic module and terminal block.

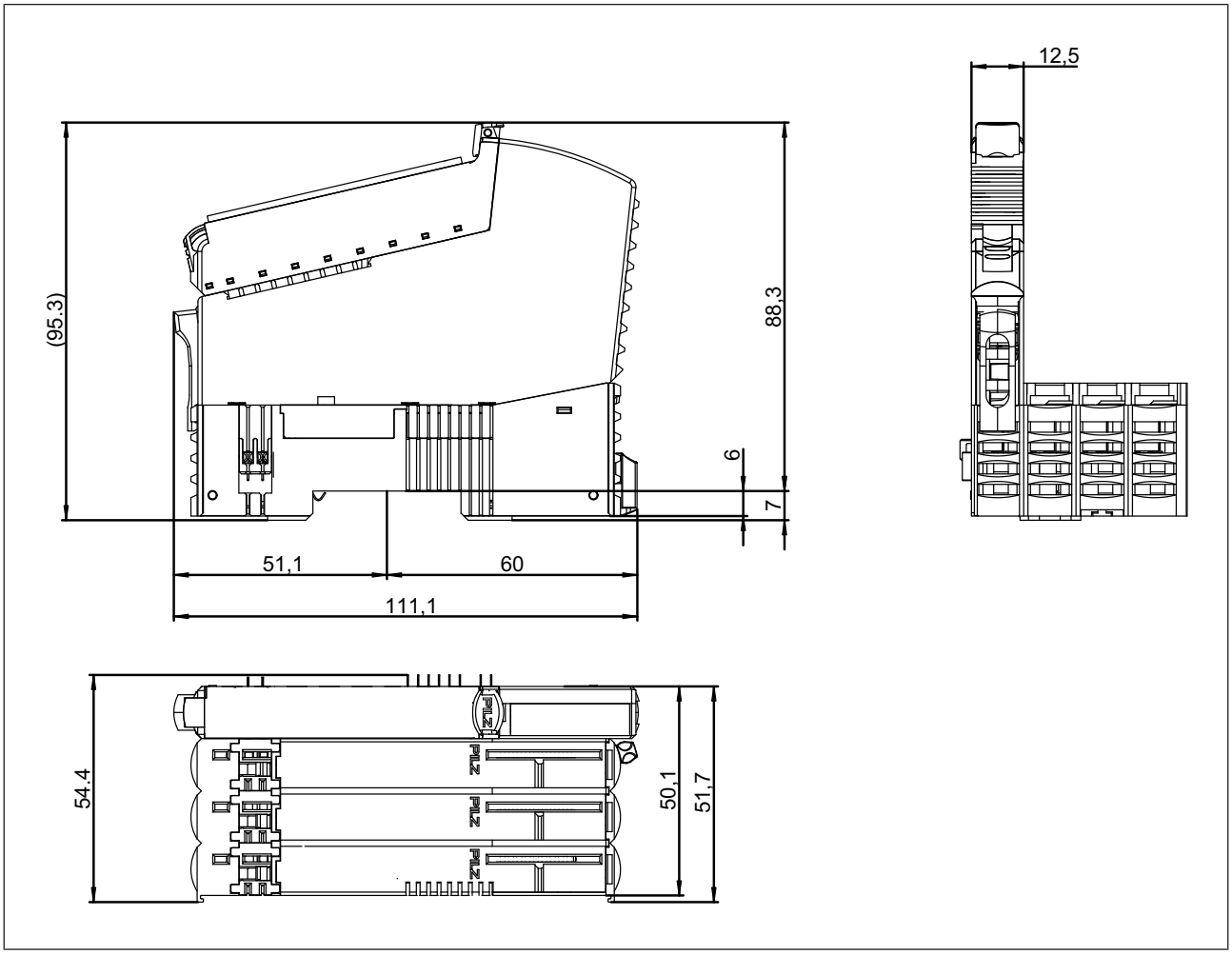


Fig.: Dimensions in mm, including backplane, electronic module and terminal block

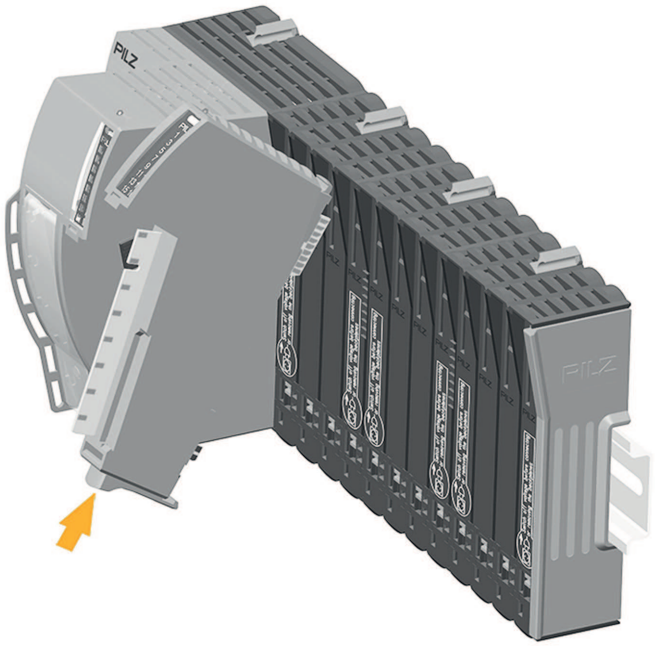
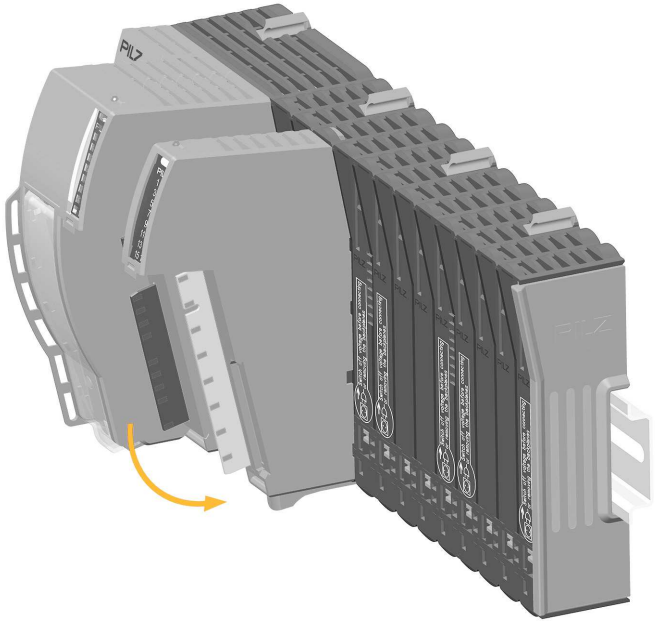
8.2 Inserting and removing an electronic module

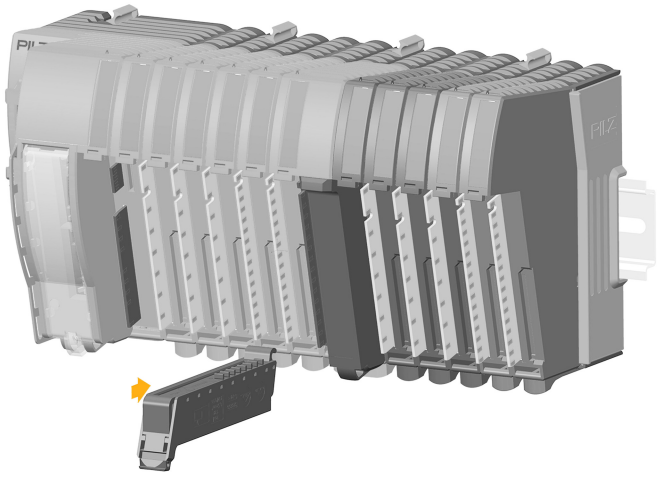
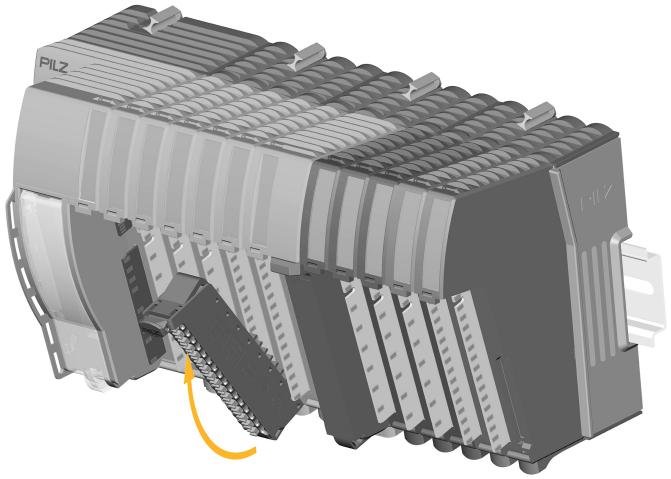
Please note:

- Backplane must be installed first.
- Electronic modules may only be plugged or unplugged if the terminal block has been removed first.
- The mechanics of the electronic modules are designed for 20 plug in/out cycles.

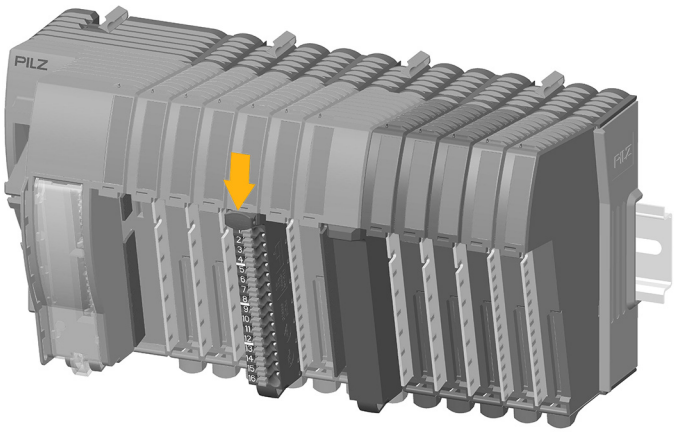
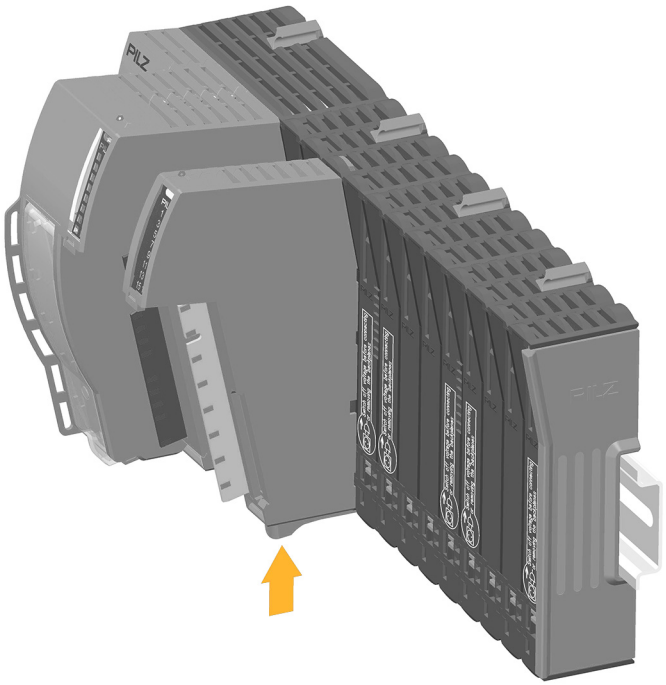
The following illustrations in chapters "Inserting an electronic module", "Removing an electronic module" and "Changing an electronic module during operation" are displayed as an example in the remote I/O system PSS u2 (see Terminology [📖 5]).

8.2.1 Inserting an electronic module

1. Insert the electronic module into the suspension lug on the backplane.	
2. Swivel the electronic module downwards until you hear it click into place.	

3. Insert the terminal block into the suspension lug on the module.	
4. Swivel the terminal block upwards until you hear it click into place.	

8.2.2 Removing an electronic module

1. Press the unlocking mechanism on the terminal block that is shown by the arrow and pull off the terminal block forward.	
2. Press the unlocking mechanism that is shown by the arrow and pull off the electronic module upwards.	

8.2.3 Changing an electronic module during operation

An electronic module can be hot swapped.

Effects

- Module bus communication between the other modules is not interrupted.
- The configuration data is retained (exchanging an electronic module with identical product ID).
- The module is detected automatically as soon as it is re-inserted.

Procedure

1. Removing an electronic module
2. Inserting an electronic module

A new electronic module can be inserted during operation.

Procedure (inserting an electronic module with a different product ID).

- Insert electronic module

Effects

- Module bus communication between the other modules is not interrupted.
- To detect the new module the following steps may be necessary:
  - Creating a new configuration or changing an existing configuration
  - Download of the configuration to the head module
  - Restart of the head module (supply voltage on/off) or warm reset via reset button.

9 Wiring

9.1 General wiring guidelines

- Each input is protected against overload by an internal current-limiting circuit. Over-voltages at the input must not exceed 30V.
- Do not connect any cables to terminals marked n.c. (not connected).
- The supply voltages of the actuators and encoders must meet the regulations for extra low voltages with safe separation (SELV, PELV). Failure to do so could result in electric shock.
- Use shielded signal cables. The optional shield connection element can be used to connect the shield (see Accessories).
- Use copper wiring.
- Analogue input modules detect even very small signal changes. They are therefore much more sensitive than digital inputs. In a particularly disturbed environment it can happen that signal changes caused by interferences are also detected.

  In these cases,we recommend the following measures:

  – Earth the mounting rail on both sides of the modules.

  – Earth the shield connection of the cables on both sides (on the sensor and either on the module or directly on the point where the cable enters the control cabinet).

  – Ensure that no transient currents flow across the cable screening, which may damage the cables or the connectors.

9.2 Terminal configuration

Terminal	Terminal configuration
1	I0+ current input positive
2	n.c. (not connected)
3	I0- current input negative
4	P0 shield connection
5	S0, 24 $V_{(S0)}$, Sensor supply
6	0 V
7	0 V
8	P0 shield connection
9	I1+ current input positive
10	n.c. (not connected)
11	I1- current input negative
12	P0 shield connection
13	S1, 24 $V_{(S1)}$, sensor supply
14	0 V
15	0 V
16	P0 shield connection

9.2.1 Connection examples

The signal cable must be connected to earth on both sides.

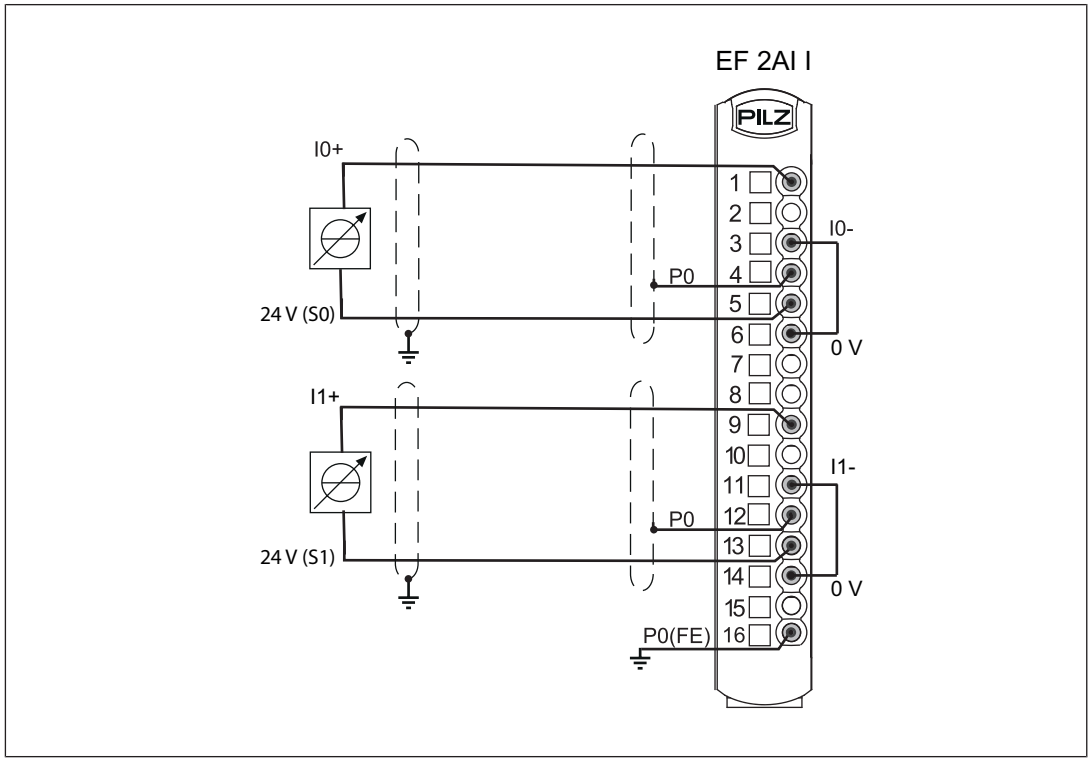


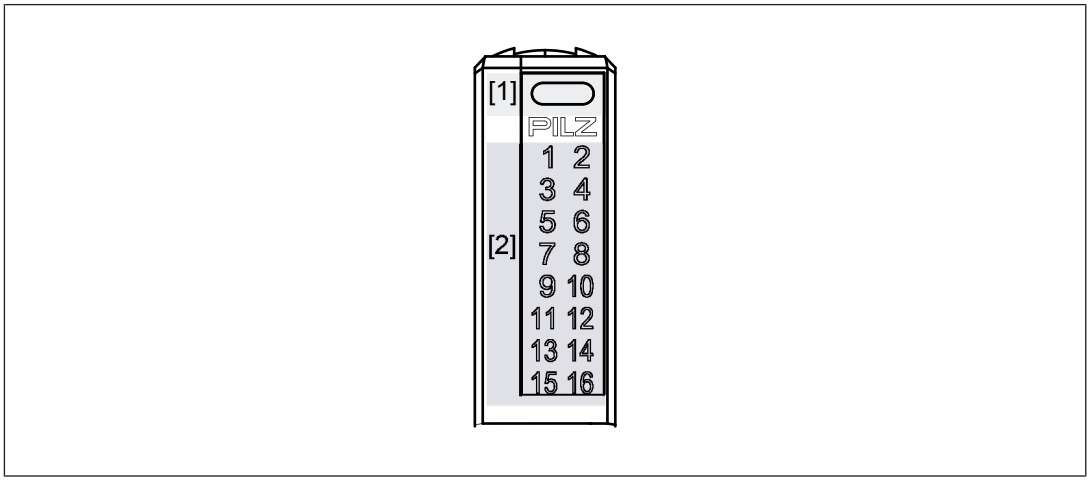
Fig.: Current measurement using two-wire technology

10 Operation

The status of the module is displayed via a red and a green LED. The status of the terminals is displayed via a green LED. If there is a module error, the module status display will light up red. The error will be signalled to the head module and will be entered in the head module's diagnostic log.

10.1 Display elements and messages

Only the terminal status displays 1,3,9 and 11 are active.



Legend

[1] Module status display

[2] Terminal status display

The module can detect the following module states:

[1]	Colour [1]	[2]	Colour [2]	Meaning	Further information
●	--	●		Module not ready for operation	
✳	Green	●		Module ready for operation	
✳	Green	✳	Green	Module in operation and there is a valid input value at the relevant input	
✳	Red	●	--	Configuration error Module was inserted in the wrong slot. Use of unreleased firmware	
✳	Red	●	--	Internal errors	See module's diagnostic log
✳	Red	✳	Green	The module status display and both terminal status displays on the relevant input flash synchronously. Measuring range error/scaling error	See module's diagnostic log

[1]	Colour [1]	[2]	Colour [2]	Meaning	Further information
	Red		Green	Temperature warning: too warm [1] Warning, e.g. undervoltage	See module's diagnostic log
	Red		Green	The module status display and all terminal status displays flash synchronously. Periphery supply is missing/temperature error: too hot [1]/sensor supply overloaded	See module's diagnostic log

Legend

 LED on

 LED flashes

 LED flashes

 LED off

[1] There are two levels of overtemperature.

- Too warm:

  If the module temperature exceeds a threshold value, then:

  – a warning is sent to the head module.

  If the temperature drops back below the threshold value, the module sends an all-clear.

- Too hot:

  If the module temperature exceeds another threshold value, then:

  – an error message is sent to the head module.

  – the FS inputs in the PII are set to "0".

  – the valid bits for the inputs are set to "0".

  After the "too hot" message has been received, if the temperature drops back below the "too warm" threshold value, the module will switch to an error-free state.

10.2 Function test during commissioning

NOTICE

For the commissioning and after every user program change, you must check whether the safety devices are functioning correctly.

11 Technical details

Where standards are undated, the 06-2024 valid editions apply.

General	328200	327200
Certifications	**CE, EAC, TÜV, UKCA, cULus Listed**	**CE, EAC, TÜV, UKCA, cULus Listed**
Application range	**Failsafe**	**Failsafe**
Module's device code	**405Ch**	**4C5Ch**
Electrical data	**328200**	**327200**
Supply voltage		
Max. power consumption of an input	**0,17 W**	**0,17 W**
Internal voltage supply (module supply)		
Module's power consumption	**0,55 W**	**0,55 W**
Periphery's voltage supply (periphery supply)		
Module's power consumption with no load	**0,9 W**	**0,9 W**
Max. power consumption of a voltage output	**0,04 W**	**0,04 W**
Max. power dissipation of module	**1,9 W**	**1,9 W**
Process data remote IO system PSS u2	**328200**	**327200**
Number of FS input bytes; if the assignment is incomplete, the assigned bits are stated in brackets	**8 (64)**	**8 (64)**
Analogue inputs	**328200**	**327200**
Number of analogue inputs	**2**	**2**
Type of analogue inputs	**Current**	**Current**
Measuring ranges		
Type	**Differential input**	**Differential input**
Measuring range	**0 - 25,6 mA**	**0 - 25,6 mA**
Input filter	**RC filter, 1st order**	**RC filter, 1st order**
Cutoff frequency	**1540 Hz**	**1540 Hz**
Current measurement		
Value of least significant bit (LSB)	**0,78125 µA**	**0,78125 µA**
input resistance	**156 Ohm + approx. 1.6 V threshold voltage**	**156 Ohm + approx. 1.6 V threshold voltage**
Max. continuous voltage	**30 V**	**30 V**
Resolution	**15 Bit**	**15 Bit**
Safety-related accuracy (1 input)	**2,5 %**	**3 %**

Analogue inputs	328200	327200
Deviations from the measuring range limit value		
Linearity error	**0,05 %**	**0,05 %**
Output variable error at 25 °C	**0,6 %**	**0,6 %**
Temperature coefficient	**0,008 %/K**	**0,008 %/K**
Repetition accuracy at 25 °C	**0,05 %**	**0,05 %**
Conversion method	**Successive approximation**	**Successive approximation**
Software filter time (averaging)	**0,1 ms, 0,2 ms, 0,5 ms, 1 ms, 2 ms, 5 ms, 10 ms, 16,7 ms, 20 ms**	**0,1 ms, 0,2 ms, 0,5 ms, 1 ms, 2 ms, 5 ms, 10 ms, 16,7 ms, 20 ms**
Potential isolation	**Yes**	**Yes**
Voltage outputs	**328200**	**327200**
Number of outputs for periphery supply	**2**	**2**
Function of outputs for periphery supply	**Sensor supply**	**Sensor supply**
Rated voltage	**24 V DC**	**24 V DC**
Max. output current at rated voltage	**0,5 A**	**0,5 A**
Short circuit-proof	**Yes**	**Yes**
Potential isolation	**Yes**	**Yes**
Typ. threshold value for overload	**0,9 A**	**0,9 A**
Environmental data	**328200**	**327200**
Application site		
in accordance with the standard	–	**EN 50125-3**
Application site	–	**Minimum 1m distance from track**
Climatic suitability	**EN 60068-2-1, EN 60068-2-2, EN 60068-2-30, EN 60068-2-78, EN IEC 60068-2-14**	**EN 60068-2-1, EN 60068-2-2, EN 60068-2-30, EN 60068-2-78, EN IEC 60068-2-14**
Ambient temperature		
Temperature range	**-25 - 60 °C**	**-40 - 70 °C**
in accordance with the standard	**UL 61010**	**UL 61010**
Max. temperature in accordance with UL	**-25 - 60 °C**	**-40 - 60 °C**
Storage temperature		
Temperature range	**-40 - 70 °C**	**-40 - 70 °C**
Climatic suitability		
in accordance with the standard	**EN 60068-2-78**	**EN 60068-2-78**
Humidity	**95 % r. h. at 40 °C**	**95 % r. h. at 40 °C**
Condensation during operation	**Not permitted**	**EN 60068-2-30**
Max. operating height above SL	**5000 m**	**5000 m**
EMC	**EN 12015, EN 12016, EN 298, EN 50156-1, EN 61000-6-7, EN 61131-2 (Zone B), EN IEC 61000-6-2, EN IEC 61000-6-4**	**EN 12015, EN 12016, EN 298, EN 50121-4, EN 50156-1, EN 61000-6-7, EN 61131-2 (Zone B), EN IEC 61000-6-2, EN IEC 61000-6-4**

Environmental data	328200	327200
Vibration		
in accordance with the standard	**EN 60068-2-6**	**EN 60068-2-6**
Frequency	**8,4 - 150 Hz**	**8,4 - 150 Hz**
Acceleration	**10 m/s²**	**10 m/s²**
Broadband noise		
in accordance with the standard	–	**EN 60068-2-64**
Frequency	–	**5 - 2.000 Hz**
Acceleration	–	**2,3 m/s² eff.**
Shock stress		
in accordance with the standard	**EN 60068-2-27**	**EN 60068-2-27**
Number of shocks	**6**	**6**
Acceleration	**150 m/s²**	**150 m/s²**
Duration	**11 ms**	**11 ms**
in accordance with the standard	**EN 60068-2-27**	**EN 60068-2-27**
Number of shocks	**1000**	**1000**
Acceleration	**100 m/s²**	**100 m/s²**
Duration	**16 ms**	**16 ms**
Airgap creepage		
in accordance with the standard	**EN 50156-1, EN 81-20**	**EN 50156-1, EN 81-20**
Overvoltage category	**III**	**III**
Pollution degree	**2**	**2**
in accordance with the standard	**EN 61131-2**	**EN 61131-2**
Overvoltage category	**II**	**II**
Pollution degree	**2**	**2**
in accordance with the standard	–	**EN 50124-1**
Overvoltage category	–	**OV2**
Pollution degree	–	**PD2**
Protection type		
in accordance with the standard	**EN 60529**	**EN 60529**
Housing	**IP20**	**IP20**
Terminals	**IP20**	**IP20**

Potential isolation	328200	327200
Potential isolation	**not evaluated by UL**	**not evaluated by UL**
Potential isolation between	**Analogue input and Module Supply**	**Analogue input and Module Supply**
Type of potential isolation	**Functional insulation**	**Functional insulation**
Rated surge voltage in operating heights up to max. 2000 m	**2500 V**	**2500 V**
Rated surge voltage in operating heights up to max. 5000 m	**2200 V**	**2200 V**
Potential isolation between	**Analogue input and Periphery Supply**	**Analogue input and Periphery Supply**
Type of potential isolation	**Functional insulation**	**Functional insulation**
Rated surge voltage in operating heights up to max. 2000 m	**2500 V**	**2500 V**

Potential isolation	328200	327200
Rated surge voltage in operating heights up to max. 5000 m	**2200 V**	**2200 V**
Potential isolation between	**Analogue input and P0**	**Analogue input and P0**
Type of potential isolation	**Functional insulation**	**Functional insulation**
Rated surge voltage in operating heights up to max. 2000 m	**2500 V**	**2500 V**
Rated surge voltage in operating heights up to max. 5000 m	**2000 V**	**2000 V**
Potential isolation between	**Periphery supply and module supply**	**Periphery supply and module supply**
Type of potential isolation	**Functional insulation**	**Functional insulation**
Rated surge voltage in operating heights up to max. 2000 m	**2500 V**	**2500 V**
Rated surge voltage in operating heights up to max. 5000 m	**2200 V**	**2200 V**
Mechanical data	**328200**	**327200**
MTBF at 40 °C, 100 % duty cycle (8760 hours/year)	–	**141 Jahre**
Material		
Housing	**PC**	**PC**
Mounting type	**plug-in**	**plug-in**
Dimensions		
Height	**110,8 mm**	**110,8 mm**
Width	**12,5 mm**	**12,5 mm**
Depth	**72,5 mm**	**72,5 mm**
Weight	**42 g**	**42 g**

11.1 Safety-related characteristics for industrial applications

The safety-related characteristics are valid for the following application areas:

- Use on machinery and in industrial environments (2006/42/EU and 2023/1230/EU)
- Use in lifts and on escalators (2014/33/EU)
- Use in combustion plants (2015/2193/EU)

NOTICE

You must comply with the safety characteristic data in order to achieve the required safety level for your plant/machine.

Operating mode	EN ISO 13849-1 PL	EN ISO 13849-1 Category	EN IEC 62061 SIL CL/max. SIL	EN IEC 62061 61508 PFH [1/h]	EN IEC 61511 61508 SIL	EN IEC 61511 61508 PFD	EN ISO 13849-1 T_M [year]
1-channel	**PL d**	**Cat. 2**	**SIL 2**	**2,14E-10**	**SIL 2**	**1,87E-05**	**20**

Operating mode	EN ISO 13849-1 PL	EN ISO 13849-1 Category	EN IEC 62061 SIL CL/max. SIL	EN IEC 62061 61508 PFH [1/h]	EN IEC 61511 61508 SIL	EN IEC 61511 61508 PFD	EN ISO 13849-1 T_M [year]
2-channel	**PL e**	**Cat. 4**	**SIL 3**	**1,16E-10**	**SIL 3**	**1,01E-05**	**20**

Explanatory notes for the safety-related characteristic data:

- T_M is the maximum mission time in accordance with EN ISO 13849-1. The value also applies as the retest interval in accordance with EN IEC 61508-6 and EN IEC 61511 and as the proof test interval and mission time in accordance with EN IEC 62061.

All the units used within a safety function must be considered when calculating the safety characteristic data.

INFORMATION

A safety function's SIL/PL values are **not** identical to the SIL/PL values of the products used and may differ from these.

The safety-related characteristic data (PFH, PFD) are mean values. They have been calculated at an average ambient component temperature of 40 °C.

11.2 Safety-related characteristics of the safety outputs

Safety-related characteristic data for railway applications must be considered for the overall system, see Safety Manual for Safety Architectures for Railway Applications (1006614).

The mission time of the module is T_M = 20 years.

12 Supplementary data

12.1 Operating height

The values stated in the technical details apply to the use of the device in operating heights up to max. 2000 m above SL. When used at higher levels, restrictions of the max. ambient temperature (standard IEC 61131-2) must be taken into account.

Operating height above SL [m]	Multiplication factors for the devices' max. ambient temperature
0 … 2000	1.0
3000	0.9
4000	0.8
5000	0.7

13 Order reference

13.1 Product

Product type	Features	Product ID
PSS u2 EF 2AI I	PSS u2, electronic module, failsafe, 2 analogue inputs for current measurement, 0 ... 25.6 mA, dual-pole, 15-bit resolution, can be configured separately, terminal block PSS u2 T 16 required (not included in the scope of delivery)	328200
PSS u2 EF 2AI I -R	PSS u2, electronic module, failsafe, 2 analogue inputs for current measurement, 0 ... 25.6 mA, dual-pole, 15-bit resolution, can be configured separately, for increased environmental requirements and railway applications, terminal block PSS u2 T 16 required (not included in scope of delivery)	327200

13.2 Accessories

Terminal block

Product type	Features	Product ID
PSS u2 T 16 (1 pc.)	Terminal block 16-pin, scope of delivery: 1 piece	328850
PSS u2 T 16 (10 pcs.)	Terminal block 16-pin, scope of delivery: 10 pieces	328851
PSS u2 T 16 (5 x 10 pcs.)	Terminal block 16-pin, scope of delivery: 50 pieces	328852

Labelling bracket

Product type	Features	Product ID
PSS u2 A LC E1 (10 pcs.)	Label holder for electronic module 23.5 x 10.5 mm, scope of delivery: 10 pieces	328910
PSS u2 A LC E2 (10 pcs.)	Label holder for electronic module 103 x 10.5 mm, scope of delivery: 10 pieces	328911
PSS u2 A LA E1 (10 pcs.)	Labelling strips for electronic module 23.5 x 10.5 mm (10 x DIN A4 sheet)	328913
PSS u2 A LA E2 (10 pcs.)	Labelling strips for electronic module 103 x 10.5 mm (10 x DIN A4 sheet)	328914

Label holder for terminal block

Product type	Features	Product ID
PSS u2 A LC T3 (10 pcs.)	Label holder for terminal block 61 x 11.5 mm, scope of delivery: 10 pieces	328912

Coding elements

Product type	Features	Product ID
PSS u2 A CE E (10 pcs.)	Coding elements for electronic modules, scope of delivery: 10 pieces	328860

Backplane

Product type	Features	Product ID
PSS u2 B 1	PSS u2, accessories, backplane, for electronic modules, 1 slot, width 12.6 mm, height 107 mm, note the mounting distances	328811
PSS u2 B 4	PSS u2, accessories, backplane, for electronic modules, 4 slots, width 50.1 mm, height 107 mm, note the mounting distances	328810
PSS u2 B 1 -R	PSS u2, accessories, backplane, for electronic modules, 1 slot, for increased environmental requirements and railway applications, width 12.6 mm, height 107 mm, note the mounting distances	327811
PSS u2 B 4 -R	PSS u2, accessories, backplane, for electronic modules, 4 slots, for increased environmental requirements and railway applications, width 50.1 mm, height 107 mm, note the mounting distances	327810

Shield connection element

Product type	Features	Product ID
PSS u2 A SH 4 (10 pcs.)	Shield connection element for backplane with 4 slots, scope of delivery: 10 pieces	328820

14 EU/EC declaration of conformity

These products meet the requirements of the directive 2006/42/EC on machinery up to and including 19 January 2027, and the EU regulation 2023/1230 of the European Parliament and of the Council from 20 January 2027. The full EU and EC declaration of conformity is available to download at www.pilz.com/manuals.

Authorised representative: Pilz GmbH & Co. KG, Felix-Wankel-Str. 2, 73760 Ostfildern, Germany

15 UKCA-Declaration of Conformity

These products comply with following UK legislation: Supply of Machinery (Safety) Regulation 2008.
The complete UKCA Declaration of Conformity is available on the Internet at www.pilz.com/manuals.

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